CSC5010 Class Search Programming Project

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Solutions for A1 and B1

```
A1: DFS (Fixed Start  Goal)
Start state:
+---+---+---+
| 2 | 8 | 3 |
+---+---+---+
| 7 | 6 | 4 |
+---+---+---+
| 1 |   | 5 |
+---+---+---+
Goal state:
+---+---+---+
| 1 | 2 | 3 |
+---+---+---+
| 8 |   | 4 |
+---+---+---+
| 7 | 6 | 5 |
+---+---+---+
No solution found.
============================
B1: A* (Fixed Start  Goal)
Start state:
+---+---+---+
| 2 | 8 | 3 |
+---+---+---+
| 7 | 6 | 4 |
+---+---+---+
| 1 |   | 5 |
+---+---+---+
Goal state:
+---+---+---+
| 1 | 2 | 3 |
+---+---+---+
| 8 |   | 4 |
+---+---+---+
| 7 | 6 | 5 |
+---+---+---+
No solution found.
```

Solutions for A2 and B2

```
A2: DFS (Random Start  Goal)
Start state:
+---+---+---+
| 4 |   | 7 |
+---+---+---+
| 3 | 1 | 8 |
+---+---+---+
| 5 | 2 | 6 |
Goal state:
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 | 8 |
+---+---+---+
| 6 | 3 |   |
+---+---+---+
Solution path:
Solution found! Steps: 104105
...
Step 104100: Move L
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 6 | 7 | 2 |
+---+---+---+
| 3 |   | 8 |
+---+---+---+
Step 104101: Move L
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 6 | 7 | 2 |
+---+---+---+
|   | 3 | 8 |
+---+---+---+
Step 104102: Move U
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
|   | 7 | 2 |
+---+---+---+
| 6 | 3 | 8 |
+---+---+---+
Step 104103: Move R
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 |   | 2 |
+---+---+---+
| 6 | 3 | 8 |
+---+---+---+
Step 104104: Move R
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 |   |
+---+---+---+
| 6 | 3 | 8 |
+---+---+---+
```

```
Step 104105: Move D
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 | 8 |
+---+---+---+
| 6 | 3 | |
+---+---+---+
============================
B2: A* (Random Start  Goal)
Start state:
+---+---+---+
| 4 | | 7 |
+---+---+---+
| 3 | 1 | 8 |
+---+---+---+
| 5 | 2 | 6 |
+---+---+---+
Goal state:
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 | 8 |
+---+---+---+
| 6 | 3 | |
+---+---+---+
Solution path:
Solution found! Steps: 27
Step 0: Initial State
+---+---+---+
| 4 | | 7 |
+---+---+---+
| 3 | 1 | 8 |
+---+---+---+
| 5 | 2 | 6 |
+---+---+---+
Step 1: Move D
+---+---+---+
| 4 | 1 | 7 |
+---+---+---+
| 3 | | 8 |
+---+---+---+
| 5 | 2 | 6 |
+---+---+---+
Step 2: Move D
+---+---+---+
| 4 | 1 | 7 |
+---+---+---+
| 3 | 2 | 8 |
+---+---+---+
| 5 | | 6 |
+---+---+---+
...
Step 25: Move D +---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | | 2 |
+---+---+---+
| 6 | 3 | 8 |
+---+---+---+
Step 26: Move R
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 | |
+---+---+---+
| 6 | 3 | 8 |
+---+---+---+
Step 27: Move D
+---+---+---+
| 1 | 4 | 5 |
+---+---+---+
| 7 | 2 | 8 |
+---+---+---+
| 6 | 3 | |
+---+---+---+
```

Conclusion and Comparison

In this assignment, the 8-puzzle problem is solved using two search algorithms: Depth-First Search (DFS) and A* search with the Manhattan distance heuristic. According to the assignment requirements and the student ID being odd, DFS is used for Tasks A1 and A2, while A* search is used for Tasks B1 and B2.

For Tasks A1 and B1, both DFS and A* failed to find a solution. This result is theoretically correct, as the given start and goal states have different inversion parity. Since the parity of an 8-puzzle configuration is preserved under all legal moves, the puzzle instance is unsolvable.

For Tasks A2 and B2, the start and goal states are randomly generated using the student ID as the random seed and are guaranteed to be solvable. In Task A2, DFS successfully found a solution but required 104,105 steps, indicating that DFS may explore a large portion of the search space and produce a very long solution path. In contrast, Task B2 shows that A* search found a solution in only 27 steps. This significant difference demonstrates the effectiveness of the heuristic function in A*, which guides the search toward the goal and greatly improves efficiency compared to uninformed DFS.